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NOTES ON THE ANATOMY OF THE VISCERA OF THE GIANT PANDA (*AILUROPODA MELANOLEUCA*)

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INTRODUCTION

The material forming the subject of this report was preserved in the the field by Mr. Donald Carter, naturalist of the Dean Sage West China Expedition.

Though previous expeditions had secured skins and skeletal material of the giant panda, this is, I believe, the first time anyone has preserved the viscera for anatomical investigation and we greatly appreciate the trouble that was taken to secure this important material. In view of the unique character of the material and its possible bearing upon the question of the relationships of *Ailuropoda* to *Ailurus*, the procyonids and the bears, it was deemed advisable to attempt a fairly full report upon the leading anatomical characters so far as preserved in our specimen.

The animal was shot by Mr. Sage on December 8, 1934, at an altitude of 7000 feet, at Cheng Wei, twenty-five miles west of Wenchwan, Szechuan, West China. It was an adult female and its measurements in the following table are compared with those of an adult female American black bear (*Euarctos americanus*) given by Seton (1929).

TABLE I

	Ailuropoda	*Euarctos*
Head and body	1460 mm.	1486 mm.
Tail	199	127
Height at shoulder	670	648
Height at rump	580	
Girth of thorax	1050	
Girth of belly	1280	
Length of hind foot	221	184
Weight		227½ lbs.

These measurements show at a glance that this female giant panda was approximately the same size as the bear.

The material consisted of nearly the whole of the viscera. The im-

perfect preservation of liver and lungs, together with the lack of such important organs as the heart and larynx, necessarily restricts the scope of the present inquiry. Nevertheless the material has been deemed worthy of careful study and comparison.

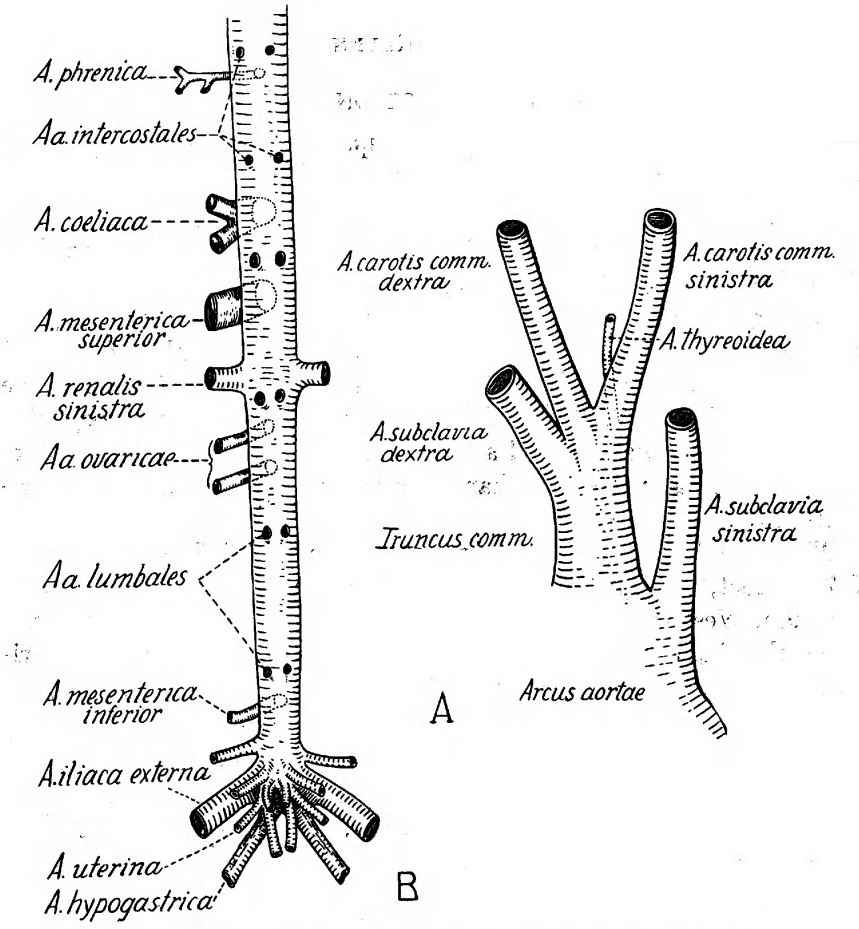

Fig. 1A. Aortic arch. B. Thoracic and abdominal aorta.

I am indebted to Dr. Herbert Fox of the Laboratory of Comparative Pathology of the Zoölogical Society of Philadelphia for the loan of part of the viscera of the small panda, *Ailurus fulgens*.

The other comparative material mentioned in the text is contained in the collections of the Department of Comparative Anatomy of The

American Museum of Natural History and was originally received from the New York Zoölogical Society, through the courtesy of that institution.

The drawings were made by Mrs. Helen Ziska.

BLOOD VESSELS

The shot that killed the animal tore away part of the upper left lobe of the lung and most of the base of the heart with its attached vessels.

Before preservation the material was divided: the anterior part of the tongue was one piece; the remaining internal organs were divided into two approximately equal parts and placed in two five-gallon oil tins with a weak solution of formaldehyde. The preservation was good, though the lungs, liver, etc., hardened very much out of shape.

The arch of the aorta (Fig. 1A) gives off two branches: the first and much the larger is the truncus communis, first giving rise to the right subclavian artery, then immediately dividing again to form the right and left common carotids. From the dorsal surface at the base of the left common carotid a small branch is given off which supplies the left lobe of the thyroid gland. Next beyond the truncus communis is the left subclavian artery. Thus in *Ailuropoda* the branches of the aortic arch conform to a pattern common to Carnivora. Parsons remarks (with reference to the arrangement of the branches of the aortic arch):

"... the terrestrial carnivora show little variation, and what there is depends on whether the left carotid rises from the cephalic part of the innominate, or whether the two carotids are fused into a common trunk for a short distance after the right subclavian is given off."

In *Ailuropoda* the carotids are fused for a short distance after the right subclavian is given off. The following table shows how this character is distributed among the Carnivora.

Caudad 15 mm. to the origin of the left subclavian artery on the dorsal side of the aorta, a single very small artery is given off and from there backward are pairs of segmental arteries (Fig. 1B) with the right one of the pair of those in the thoracic region slightly more caudad.

Rostrad of the diaphragm there are nine pairs of segmental arteries, and caudad to the diaphragm seven pairs, including the two pairs that form the terminus of the aorta. The phrenic artery is single; it comes from the ventral surface of the caudal part of the thoracic aorta.

The renal arteries are directly opposite each other. The ovarian arteries take origin, one behind the other, from the mid-ventral line of the abdominal aorta.

TABLE II.—Arrangement of Branches of Aortic Arch in Carnivora. (Partly after Parsons, 1902.)

		TYPE A	TYPE B
Felidae	*Felis leo*	4/4	
	" *pardalis*	1/2	1/2
	" *catus*		3/3
	" *tigris*		2/2
	" *pardus*		1/1
	" *concolor*		1/1
	" *tigrina*		1/1
Viverridae	*Herpestes*	1/1	
	Cryptoprocta	1/1	
	Nandinia	1/1	
	Genetta	1/2	
	Arctictis	1/1	
Hyaenidae	*Hyaena*	1/1	
Canidae	*Lycaon*	2/2	
	Canis familiaris	4/4	
	" *lupus*	1/1	
	" *vulpes*	3/3	
Procyonidae	*Procyon*	2/3	1/3
	Cercoleptes		1/1
	Nasua	1/3	2/3
	Ailurus fulgens		1/1
	Ailuropoda melanoleuca		1/1
Ursidae	*Euarctos americanus*		2/2
	Helarctos		1/1
Mustelidae	*Galictis vittata*	1/1	
	" *barbara*	1/1	
	Ictonyx	1/1	
	Mustela erminia	2/2	
	" *putorius*	2/2	
	Lutra	1/1	
	Gulo		1/1

The inferior mesenteric artery is very small and has its origin about 3 cm. from the termination of the aorta.

The terminal branches of the aorta are unlike those of anything I have seen except in *Ailurus*. The external iliac arteries are the largest branches, the left one slightly higher than the right. Caudad to the external iliac arteries are the hypogastric arteries, intimately connected with and parallelled by a fibrous cord of connective tissue. Between the external iliac and the hypogastric arteries and more dorsal is a pair of arteries sending branches to the uterus. As the remaining small arteries, four pairs, had been cut off short, their distribution could not be ascertained.

The vena cava inferior is double up to the level of the middle of the kidneys (Fig. 12A and B). This condition is reported by Beddard (1909, p. 493) for a number of carnivores. He writes as follows: "Thus it is the Arctoid Carnivora, and possibly chiefly the Musteline division of that group, in which the double postrenal postcaval vein is to be met with." In *Ailurus* I found the condition of the postrenal-postcaval vein to be approximately the same as in *Ailuropoda*.

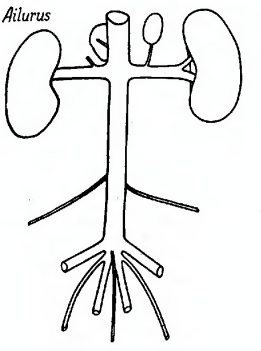

Fig. 2. Abdominal aorta of *Ailurus*.

The renal veins of *Ailuropoda* are decidedly asymmetrical in their entrance into the vena cava inferior; that of the left side is more caudad, thus agreeing with *Ailurus*, *Cercoleptes*, *Euarctos* and *Vulpes*. In *Nasua* and *Procyon* the left renal vein enters the vena cava posterior in advance, rostrad of that of the right side and in *Helarctos* they are opposite each other. Beddard (p. 493) states that: "The Arctoid genera, in their wide distribution, nearly plantigrade feet, only at most slightly specialized carnassial teeth, and with their nonretractile claws, lie at a lower level than the Aeluroidea. This result may be perhaps taken into consideration along with the postrenal section of the postcaval. In the

same direction also points the more usual symmetry in the position of the renal veins; these very frequently, more frequently than in the Aeluroidea, open into the postcaval opposite to each other. Again, it is more common in this subdivision of the Carnivora for asymmetry to be shown in the position of the spermatic or ovarian veins."

In *Ailuropoda* the ovarian veins, though slightly asymmetrical, join the vena cava posterior just caudad to the renal veins. This is the case in *Ailurus*, though in the latter they are a little more caudad. In the procyonids, ursids and canids mentioned above the right ovarian (or spermatic) vein joins the vena cava inferior directly, whereas the left one joins the left renal vein.

TRACHEA AND LUNGS, THYROID GLAND

The trachea (Fig. 3) had been cut through near the upper pole of the thryoid gland, so the exact number of tracheal rings could not be determined, but in the part that remained are twenty-four rings and the total number probably did not exceed twenty-seven. In *Ailurus* there are thirty-eight cartilaginous tracheal rings, according to Flower (1870, p. 759). The trachea in *Ailuropoda* is 36 mm. in greatest diameter and the membranous part behind is 6 mm. wide. The two bronchii into which the trachea divides are short and each subdivides again into upper and lower branches. The left bronchus is a little longer and not quite as large as the right.

The left lung consists of two lobes completely separated by a fissure. The lower lobe is somewhat larger and more irregular in form than the upper.

The right lung consists of four distinct lobes. The right upper lobe, supplied by the eparterial bronchus, is about equal in size to the lower lobe of the right side. Lying between the right upper and lower lobes is the right median lobe, which is about half the size of the adjacent lobes. It is supplied by the superior ventral branch of the hyparterial bronchus. The right lower lobe is similar to the left lower lobe but slightly smaller. The ligamentous connections of the lower lobes of both sides not only surround the root but extend along their dorso-caudal margins to the diaphragm. The azygos lobe is not more than half the size of the median lobe and lies medial to the lower part of the right lower lobe. It is deeply fissured, the fissure extending nearly halfway from its apex to the root.

All the lobes are separate, that is, not connected by lung tissue at

their roots. In this character *Ailuropoda* differs from *Ailurus*. In general, however, they conform to the usual carnivore pattern.

The right thyroid body was not preserved. The left half of the gland (Fig. 3), however, is nearly complete and measures 55 mm. in greatest length by 25 mm. in width. It is irregularly lobulated, nearly straight

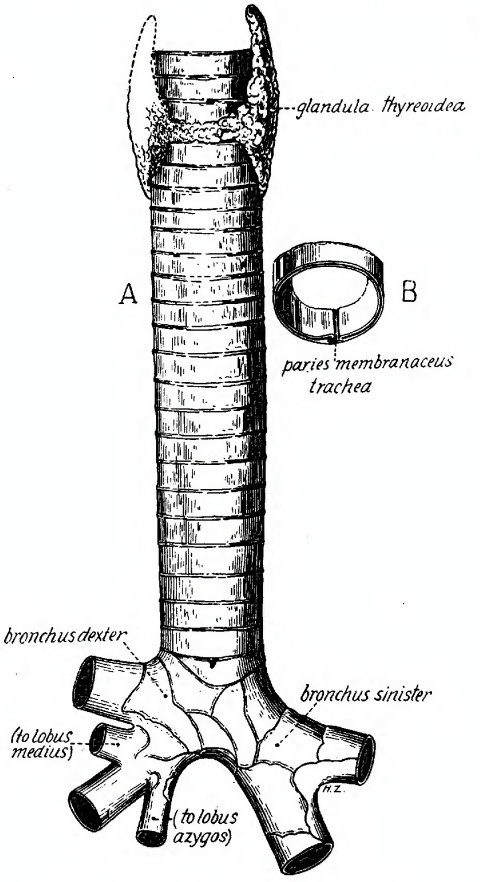

Fig. 3. Trachea and thyroid gland.

on its medial border. The dorso-lateral border is convex. The isthmus curves downward to the median line and measures 25 mm. in length from the right to the left parts of the gland, by 10 mm. in width.

ALIMENTARY TRACT

The preserved oral part of the tongue (Fig. 4) measures 14 cm. in length, 13 cm. from the most rostrad of the vallate papillae to the apex

of the tongue. Its greatest width is just behind the middle, where it measures 5 cm. The tip is free for 7 cm.

The tongue is covered with four kinds of papillae. The most abundant and the most variable are the conical papillae, which are large near the apex, above and below, also along the lateral borders and in the region of the vallate papillae. They are very small and close set over most of the dorsum of the tongue and lacking on the sides and under sur-

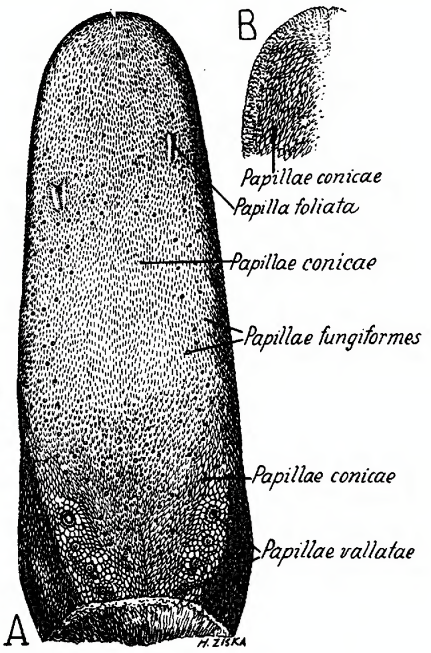

Fig. 4. Tongue.

face, except near the apex and adjacent lateral borders. Since the base of the tongue is cut off, comparisons with other arctoids are not possible.

The foliate papillae are two in number, one on each side of the dorsum of the tongue. Carlsson (p. 292) records these structures in *Ailurus*. According to Sonntag (p. 145), they occurred in *Procyon lotor*, *Ursus maritimus* and *Melursus ursinus*, but he found no trace of them in *Ailurus*, *Procyon cancrivorus*, *Nasua narica*, *Cercoleptes caudivolvulus* or many mustelids.

The fungiform papillae are rather numerous, plainly visible and well separated on the dorsum of the tongue except in its middle area, where they are entirely absent. According to Sonntag (pp. 144, 145) the fungi-

form papillae of arctoid carnivores range from "just visible to the naked eye" in the Mustelidae and some species of *Ursus* to "small but obvious" in some mustelids, *Procyon* and *Ailurus*, to relatively large and prominent in *Nasua*. Thus in size the fungiform papillae in *Ailuropoda* approach those of *Nasua* and differ from those of *Ursus*. They contrast with those of *Ailurus* (Carlsson, p. 292) in not being covered by the papillae filiformes (= conical) and in their absence from the central tract of the dorsum of the tongue, also in being less crowded together both at the base and at the apex.

The vallate papillae preserved are six pairs but had the whole tongue been preserved there might have been seven or eight pairs, or fifteen or seventeen arranged in a V-formation, the caudal part of which is now lacking. Some of the papillae vallatae are subdivided into one larger and one smaller, so that the variable number in Procyonidae as a whole (see below) is not surprising. Carlsson (1925, p. 292) and Sonntag (1923, p. 144) record the number of vallate papillae in the Procyonidae as ranging from 6 in *Bassaricyon*, 6-10 in *Cercoleptes*, 8 in *Nasua*, 12–14 in *Procyon*. The possibly high number (estimated maximum 17) in *Ailuropoda* exceeds that of *Ailurus* (11) and comes within the range in the Ursidae (16–20).

There is a very slight median fissure at the apex and extending back for a centimeter on the under side of the tongue.

The oesophagus (Fig. 7B) is flattened dorsoventrally and has a rather thick muscular coat. It is lined with a smooth, almost horny epithelium with no conspicuous glands. The inner surface is thrown into longitudinal folds that terminate abruptly at the stomach.

The stomach (Figs. 5, 6, 7) is long and slender. The fundus does not bulge excessively and from it there is a gradual tapering toward the pyloric portion, which is sharply bent upward, as described by Flower (p. 761) and by Carlsson (p. 293) for *Ailurus*, but does not agree with Flower's figure in its proportions. Along the greater curvature from the cardia to the pylorus it measures 80 cm. and in its moderately distended, food-filled condition has a greatest diameter of 13 cm. Its diameter at the pyloric sphincter is 5.5 cm. The longitudinal muscle fibers of the stomach can be seen through their peritoneal covering.

The ligamentum hepato-gastricum and a strong ligamentum hepatoduodenale, which by part of its insertion marks the position of the pyloric sphincter (Fig. 6), hold the pylorus close to the cardia and pressed against the lesser curvature of the stomach. In fact it would seem the pylorus could never move more than 10 cm. from the terminus of the

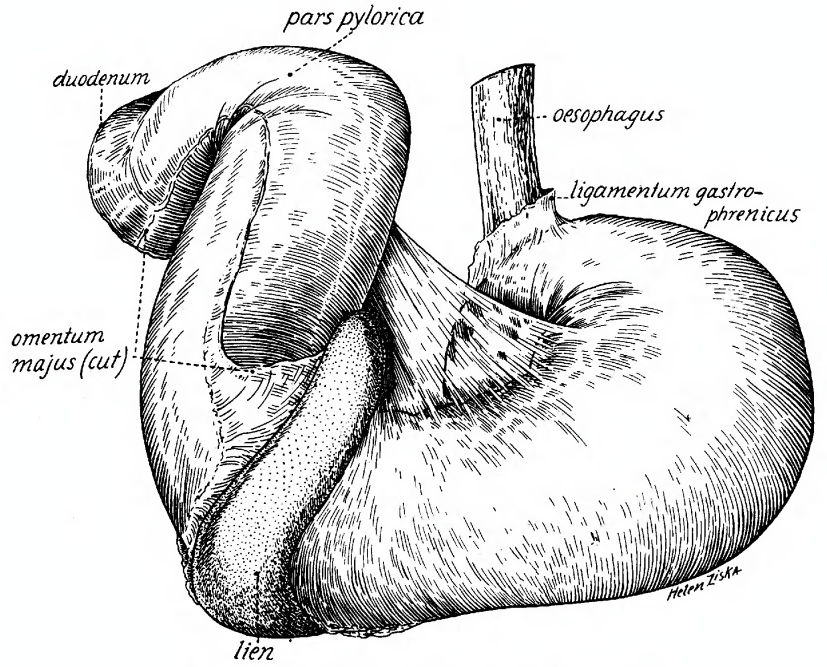

Fig. 5. Ventral or caudal view of stomach.

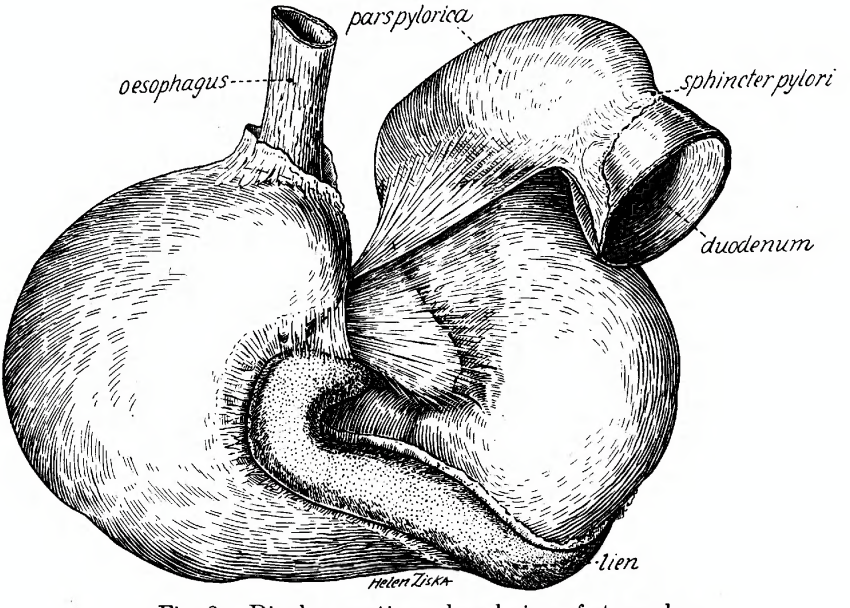

Fig. 6. Diaphragmatic or dorsal view of stomach.

oesophagus. The walls of the stomach are much stronger and thicker than those of the duodenum. The muscular coat of the pyloric region is 2 mm. in thickness, at the pyloric sphincter, 6 mm., and that of the duodenum 4 cm. from the pylorus is about 1 mm. thick. The mucosa of the stomach (Fig. 7) in the region of the fundus was thrown into a series of folds, doubtless through the contraction of the muscular walls of that region.

The mucous membrane appears alike over the whole of the organ.

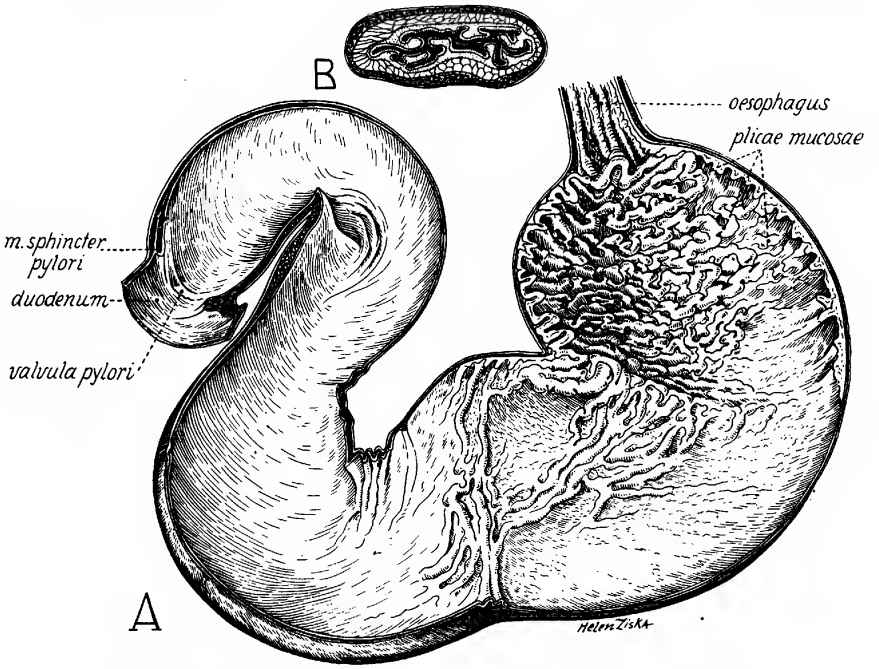

Fig. 7A. Section of stomach from oesophagus to duodenum.
B. Cross-section of oesophagus. About 1/1.

The difference between the horny lining of the oesophagus and the soft membrane lining the stomach is not alone in texture but in color; that of the oesophagus in the preserved specimen being whitish, whereas that of the stomach is dark grayish green. On the whole, the stomach of *Ailuropoda* is much like that of *Ailurus* but has relatively thicker walls.

The liver has six distinct lobes (Fig. 8). A left lateral lobe, which is simple, flattened and triangular in outline, has a thin free margin without notches. On its inferior surface opposite its free border, close to the transverse fissure, there is a small tongue-shaped accessory lobule such as

is recorded for *Ailurus* by Flower (1870, p. 762), who also says: "This lobule is slightly indicated in *Nasua*."

The left lateral lobe is overlaid in part by the left central lobe and its medial border is close to the left border of the right central or cystic lobe. The left lateral lobe is connected with the left central lobe by a triangular ligamentous band.

The left central lobe is about the same size as the former and not so flattened. It is nearly triangular, with an almost straight lateral border which is applied to the diaphragmatic surface of the left lateral lobe. From its wedge-shaped free apex its medial border is curved to its root, with but one small notch which is near its apex. It is separated from the right central lobe by the falciform ligament.

The right central lobe is larger than either of the left lobes. Viewed from behind, its general outline is oval. Its apex, which is near the ligamentum falciformis, is provided with four shallow notches. From the deepest of these there is a small ligament connected with the fundus of the gall-bladder. The gall-bladder occupies a depression at the basal half of the left side of this right central lobe, its fundus reaching but little more than half-way to the apex of the lobe. To the right of the gall-bladder and parallelling it, is a well defined fissure, the extremities of which do not reach the borders of the lobe. A wide isthmus connects the right central with the right lateral lobe. The pars quadrata is not distinct, agreeing with *Ailurus*, *Procyon* and *Nasua* and in contrast with *Ursus*, in which it is prominent (Carlsson, p. 295).

The right lateral lobe is nearly round in outline and larger than any of the other lobes. Its margin is devoid of notches. Intimately connected with the right lateral lobe are the two remaining lobes, the caudate lobe and the Spigelian lobe.

The caudate lobe is very small, irregular in shape, with sharp angles, and is grooved for the passage of the vena cava inferior. In *Ailurus*, according to Flower (p. 764) and Carlsson (p. 295), the caudate lobe is very large, but in my specimen the caudate lobe is small and similar to that of *Ailuropoda*. On three sides its margin is separated from the right lateral lobe by a fissure.

The Spigelian lobe is long, slender and trihedral, especially the free end. For more than half its length it is intimately connected with the right lateral lobe but also in part with the central lobe.

The gall-bladder (Fig. 8) is 6 cm. long and its duct joins the hepatic duct 5.5 cm. from the neck of the gall-bladder.

The ductus choledochus (Figs. 8 and 9) and the ductus pancreaticus

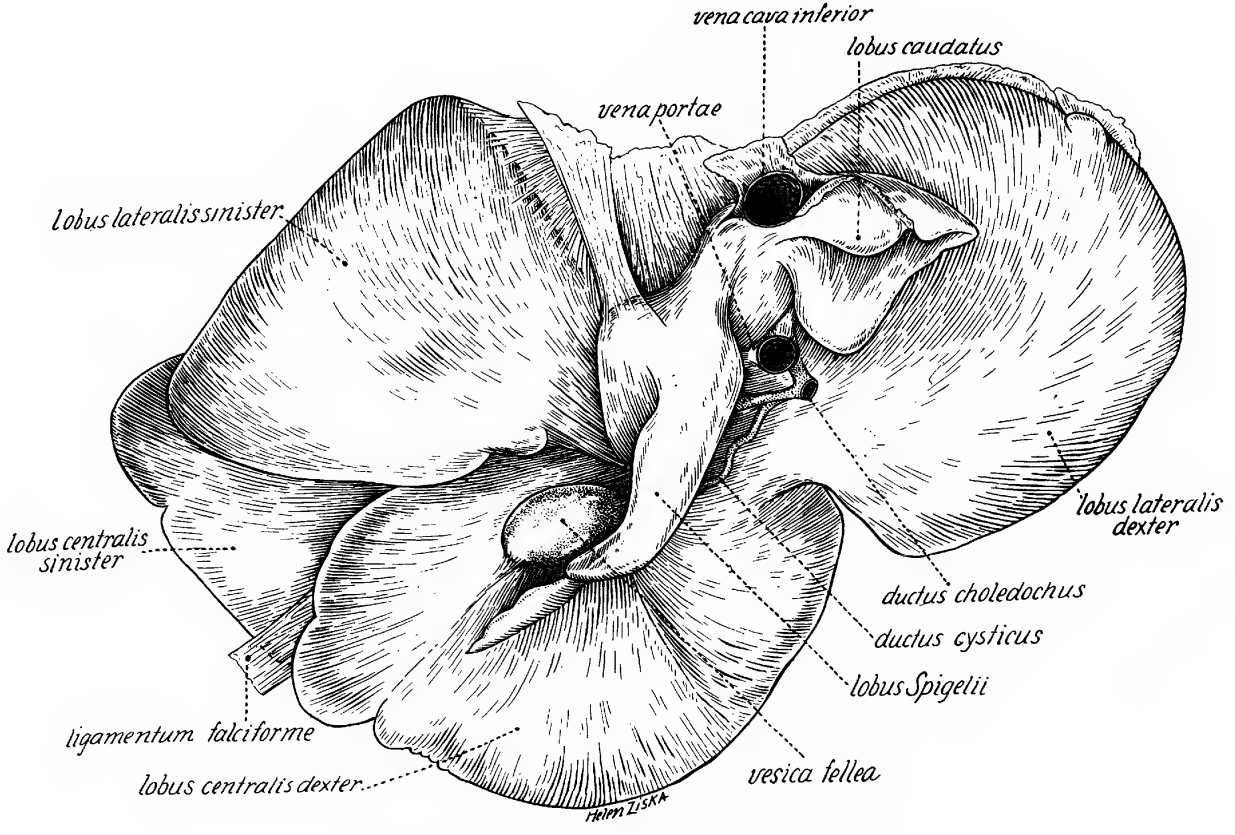

Fig. 8. The liver, ventral or abdominal view.

(Fig. 9) open into the duodenum separately, the distance between the two openings being 3 or 4 mm.

The lining of the ductus choledochus is smooth to 15 mm. from its termination. When it enters the duodenal wall it broadens somewhat

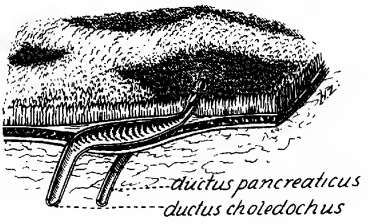

Fig. 9. A diagram of the ampulla of the bile duct and a section of the duodenum.

to form the ampulla and its inner surface is lined with lamelliform rings. The character of the lining of the ductus pancreaticus also changes when it enters the duodenal wall but its lining, though resembliug that of the ductus choledochus, has much finer rings and does not increase in diameter.

The pancreas (Figs. 10A and B) is large for a carnivore, probably as-

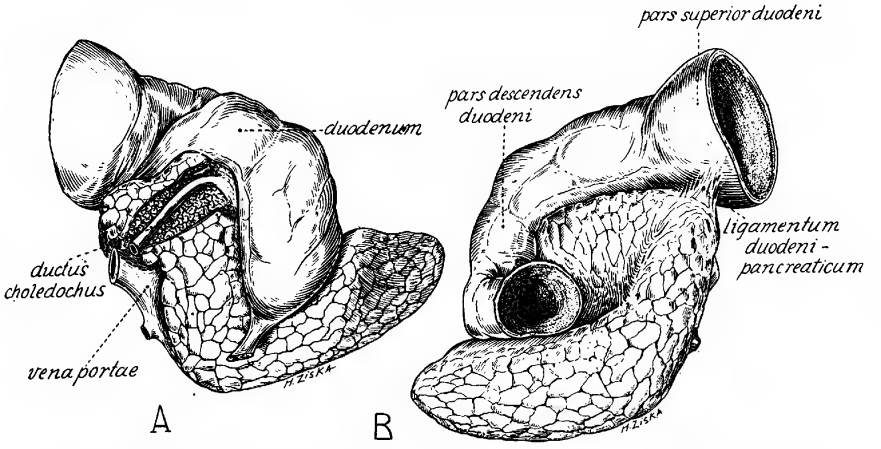

Fig. 10. Pancreas and duodenum. A. Ventral view. B. Dorsal view.

sociated with its specialized herbivorous diet, and very irregular in shape, but on the whole much more compact than in various procyonids, ursids and canids used for comparison.

The intestine is thick-walled, of fairly uniform diameter and not very long. It measures eight meters from the pyloric sphincter to the

anus in its preserved condition, without stretching, and would of course have measured more when it was fresh. Of this, 110 cm. belongs to the colon and rectum.

At the moment of death the proximal part of the duodenum was dis-

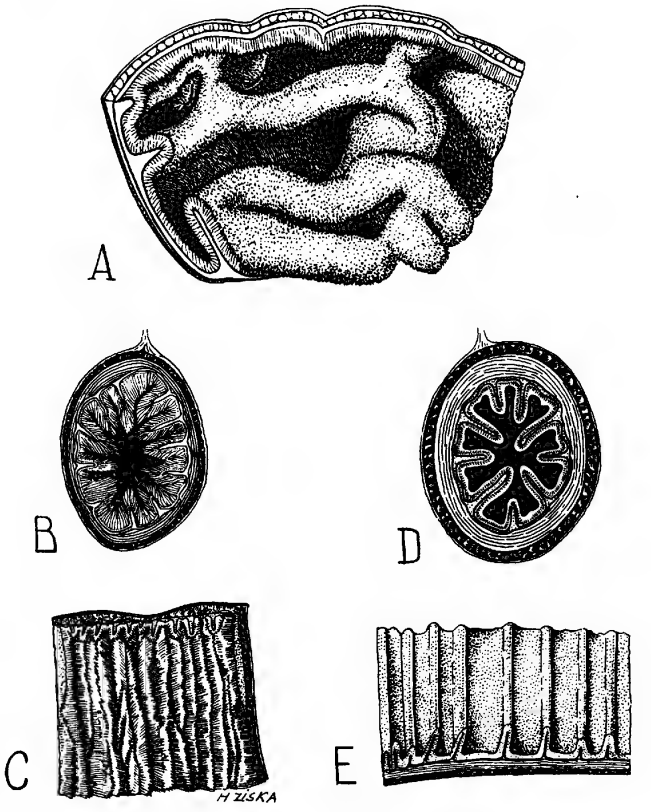

Fig. 11. Details of intestine.

A. Section of the duodenum showing character of the folds of the mucosa.
B. The small intestine; cross-section showing heavy muscular walls and villi.
C. Section opened out showing longitudinal folds covered with villi.
D. Transverse section of the colon.
E. The mucosa arranged in longitudinal folds.

tended with food, consequently its diameter is large and its mucosa devoid of folds. Beyond this it is constricted and the mucosa thrown into numerous folds (Fig. 11A), most of which are longitudinal but branch to form connections with other folds. The duodenum is lined with close-set villi, each about 2 mm. long, giving to the whole an appearance of

ivory-colored plush. The bile and pancreatic ducts empty into the duodenum 10 cm. from the pylorus. There is a duodenal fold or ligament from the lower or caudal part of the duodenum to the caudal part of the mesocolon.

The jejuno-ileum is lined with villi, differing very little in appearance from those of the duodenum. There are no Peyer's patches. Carlsson reports (p. 294) that Peyer's patches are few in *Ailurus*. In my specimen of *Ailurus* there was but one small one. In *Euarctos americanus* Peyer's patches were abundant and large. They were present also in *Cercoleptes, Procyon, Nasua.*

There is no caecum (as in *Ailurus, Nasua, Cercoleptes, Procyon, Ursus*), nor is there any external indication of the exact site of the ileo-colic junction. However, its approximate location may be determined, for beneath the peritoneal covering of the colon, on its sides as well as along the mesentery, are to be seen accumulations of fat which do not occur about the sides of the ileum. These accumulations of fat do not form epiploic appendages in this specimen.

The ileo-colic junction is well marked internally by the change in the

TABLE III

Relative lengths of the alimentary tract and its divisions in Carnivora	Length of: Colon and rectum	Jejuno-ileum	Duodenum	Stomach (grt. curv.)	Oesophagus and tongue	Alimentary tract (total)	Head and body	Proportion of head and body to alimentary tract	Proportion of alimentary tract to head and body
	cm.	cm.	cm.	cm.	cm.	cm.	cm.	%	%
Nasua	14	180	12	10	24	240	46	19.1	521
Procyon	20	256	14	14	28	332	49	14.7	677
Cercoleptes	15	126	8	12	25	188	43	22.8	437
Ailurus	15	195	13	15	?37	275	61[1]	22.1	450
Ailuropoda	110	663	27	80	59	939	146	15.6	643
Euarctos	16	579	17	35	80	727	90	12.3	807
Vulpes	24	86	17	16	36	179	62	34.6	288
Helarctos[2]	23	275	12	30	32	372	59	15.8	630
Felis yagouaroundi	21	105	12	15	26	179	46	25.6	389
Felis pardalis	23	170	16	24	39	272	69	25.3	394
Paradoxurus	21	177	9	17	28	252	47	18.6	536

[1] Head and body measurement taken from another individual of the same sex.
[2] Very young animal.

mucosa. That of the ileum (Fig. 11B and C) is lined with short villi, whereas that of the colon (Fig. 11D and E) presents a smooth surface arranged in a series of longitudinal plicae.

The proportions of different parts of the alimentary tract in various carnivores, as measured by me, are as shown in Table III.

This table shows, as might be expected, that the digestive tract is relatively longer in those forms in which vegetable matter forms a large part of the food.

SUPRARENAL GLANDS

The right suprarenal gland is situated near the upper medial pole of the kidney. This gland and the kidney are both slightly higher, more rostrad, than those of the left side. Its dorsal surface rests against the diaphragm, its ventral surface against the postcaval vein and its lateral border partly against the caudate and partly against the right lateral lobe of the liver. It measures 31 mm. in length by 23 mm. in width and 12 mm. in greatest thickness. Its main arteries are two which enter from the dorsal surface; one comes directly from the ventral border of the aorta, whereas the other arises from the right renal artery. The right suprarenal vein is very short, going directly into the side of the postcava.

The left suprarenal body rests dorsally against the diaphragm; ventrally it faces the stomach, medially the postcaval vein and laterally the rostro-medial border of the kidney. It is much larger than the suprarenal gland of the right side and measures 48 mm. in length by 27 mm. in greatest width, by 11 mm. in thickness. The main artery arises from the lower left renal artery. Its vein grooves the ventral surface of the gland and joins the postcava just above (rostrad to) the renal vein.

UROGENITAL SYSTEM

The right kidney (Fig. 12A and B) is placed slightly more craniad than that of the opposite side. Both are surrounded by a quantity of fat and are distinctly lobulated, each having six lobuli. The right kidney measures 112 mm. long by 62 mm. wide and 26 mm. thick; the left 108 mm. long, 55 mm. wide and 25 mm. thick. The kidneys differ from those of Procyonidae and *Ailurus* in being lobulated, as in most larger mammals, including the bears.

The ureter is somewhat flattened where it emerges from the kidney but for nearly the whole of its length it is nearly circular in section. It runs in the wall of the bladder for 10 mm. For a corresponding distance on the inside of the bladder there is a raised rounded ridge on which the

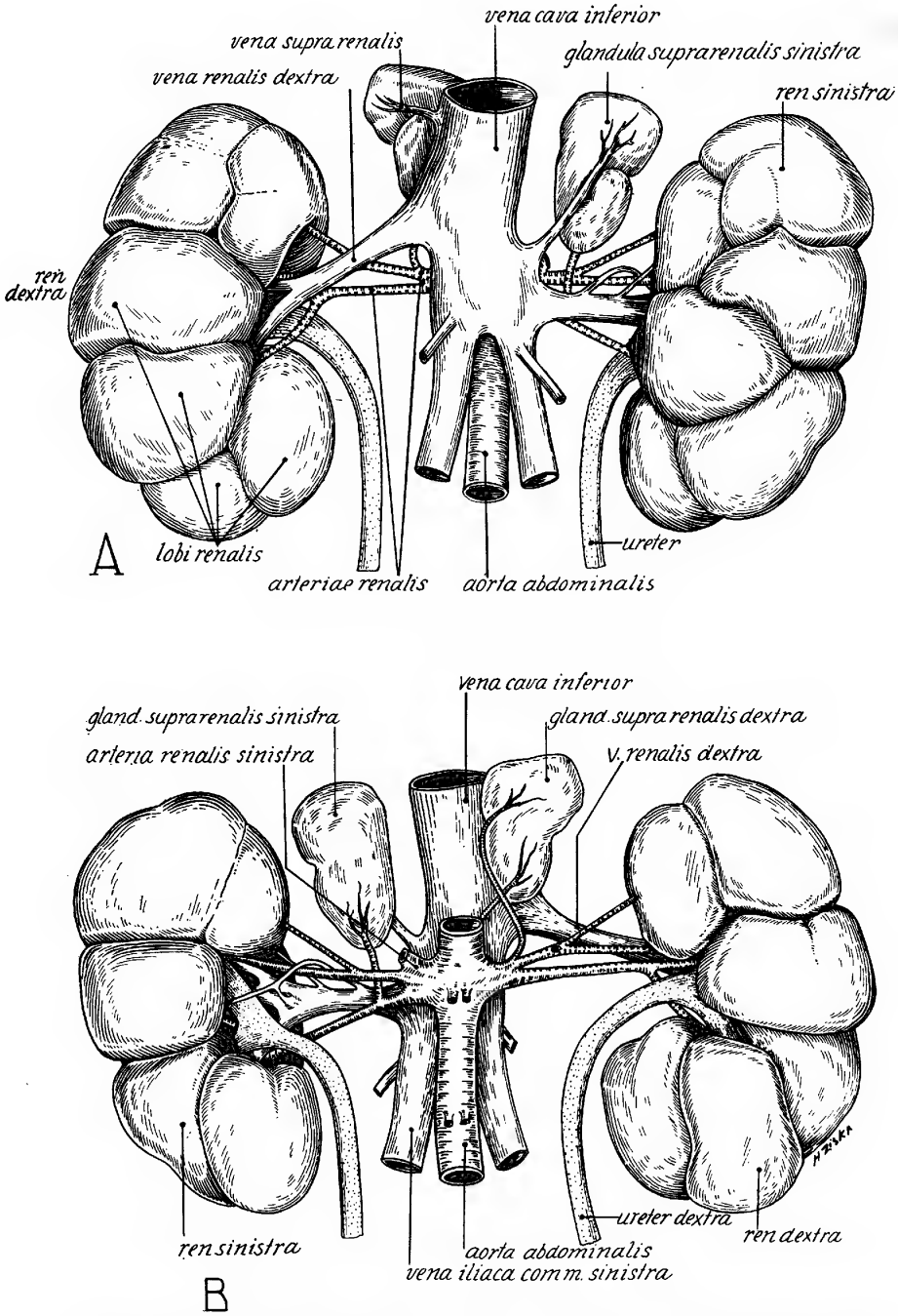

Fig. 12. Kidneys, suprarenals and their vessels. A. Ventral view. B. Dorsal view.

ureteral orifice is located. The lateral margins of the ridge of each side continue in diminished form as they converge at the opening of the urethra.

The bladder (Figs. 13 and 14C) is rather pointed and widest about the middle, with very heavy muscular walls. Its length contracted is 110 mm. From the ureteral orifice to the beginning of the urethra is 45 mm. The distance between the openings of the two ureters is 20 mm.

Behind the ureteral prominences the mucosa of the bladder is thrown

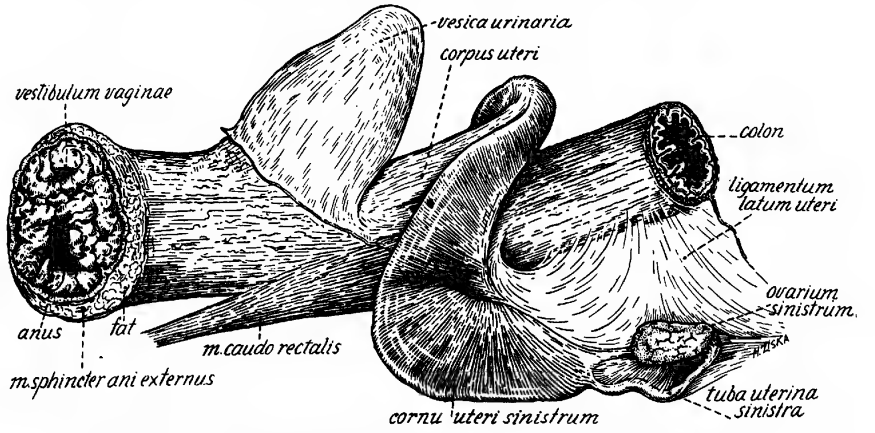

Fig. 13. Ovary, uterus, bladder and rectum, from the left side.

into a series of folds in its contracted state but that of the trigonum remains smooth.

The urethra is irregular in section, due to its longitudinal folds. The diameter of its lumen is about 3 mm. and its length is 40 mm. It opens into the urogenital sinus from a rounded tubercle 15 mm. in diameter.

The ovary is slightly flattened, rounded, and its surface is fissured and pitted, thus having somewhat the appearance on the surface of a highly convoluted brain. It measures 30 mm. in length by 23 mm. in width and 11 mm. in thickness.

The uterine tube is very much contorted but when straightened measures 95 mm.

The corpus uterus is less than half the length of the cornua and slightly depressed. The cornua are rounded on the free edge and diminish in thickness toward the broad ligament. The surface of the uterine mucosa is arranged in a mosaic with distinct clefts separating the smooth areas making up its surface. The mucosa has the same

appearance over its entire surface from the extremities of the cornua to the cervix. The cervix is strong with comparatively thick muscular walls.

The vagina, which has a total length of 85 mm., is narrow with firm muscular walls. Its mucosa forms a series of closely-set, transverse circular folds. Caudally the vagina is bounded ventrally by the tu-

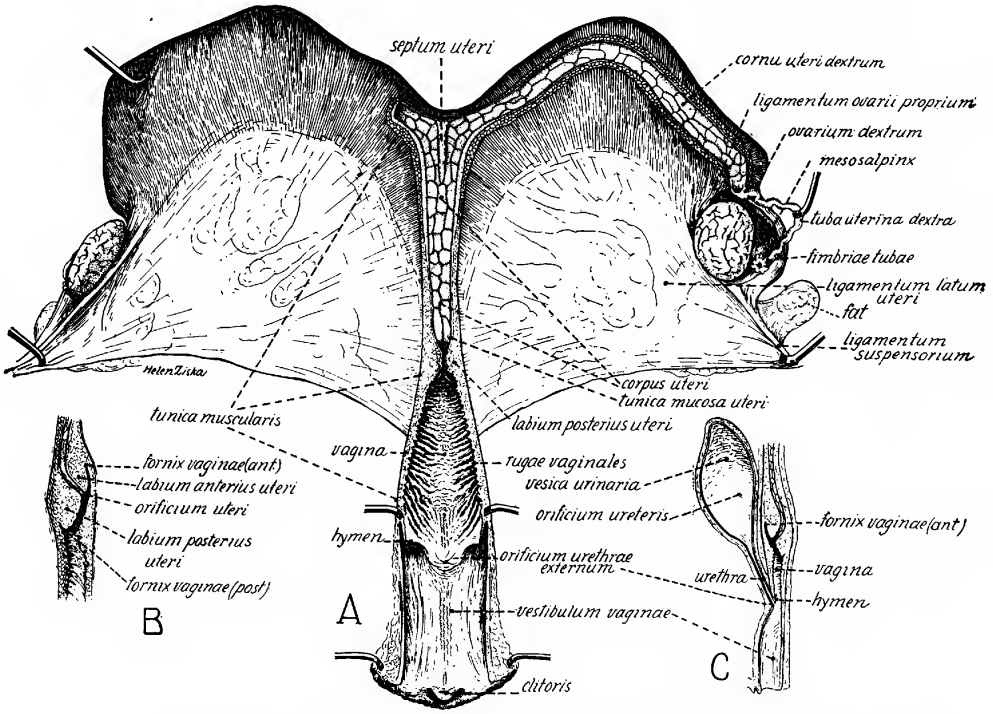

Fig. 14. Female genital apparatus.

A. From the dorsal side; vestibule and vagina opened along mid-dorsal line and spread out.

B. Median sagittal section through region of cervix, viewed from the right.

C. Median sagittal section of posterior part of urogenital apparatus, viewed from the left.

bercle, on the center of which is the urethral opening, laterally and dorsally by the hymen, which is a fold 8 mm. long.

The urogenital sinus, like the vagina and corpus uterus, is flattened so that, though not wide, it is more extensive transversely than dorsoventrally.

Of the specimen under consideration there is preserved only a very

little of the skin surrounding the genital and anal openings. It is bare except for a few hairs. On this skin are the openings of numerous glands, which when squeezed express an oily substance.

Lateral to the dorsal limit of the genital opening on each side is a rather large crypt, which contains the minute openings of many of these glands.

SUMMARY AND CONCLUSIONS

The parts of our specimen of *Ailuropoda melanoleuca* that are sufficiently well preserved to merit description include some of the larger

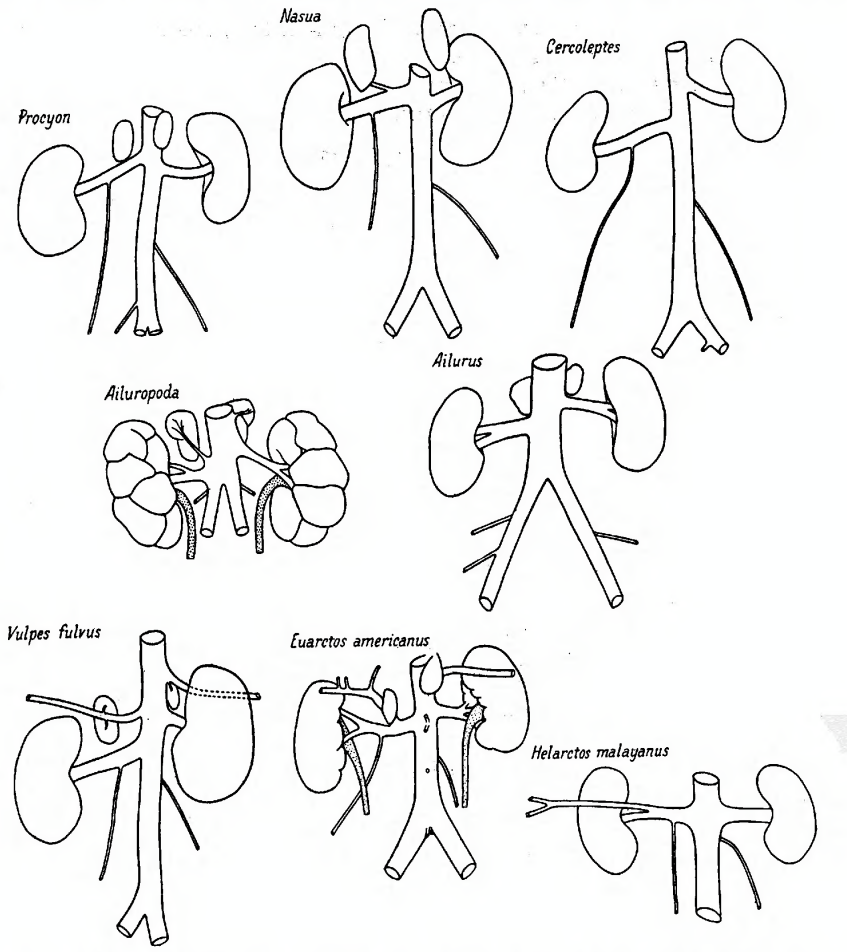

Fig. 15. Comparative views (dorsal) of vena cava inferior, renal and ovarian veins in procyonids, a canid, and two ursids.

blood vessels, the trachea, lungs, alimentary tract and female urogenital system.

The main anatomical characters of the viscera and circulatory system of *Ailuropoda* may be summarized under two main aspects: A. Habitus characters; B. Characters of taxonomic or phylogenetic significance.

A.—Habitus characters of the viscera associated with specialized herbivorous diet:

(a) The extremely horny lining of the eosophagus;
(b) The thick-walled, muscular and elongated stomach;
(c) The proportionately small size of the liver (in flesh-eaters it is relatively larger);
(d) The comparatively small size of the gall-bladder, presumably associated with more continuous feeding;
(e) The large size of the pancreas;
(f) The elongation of the jejuno-ileum.

B.—Characters of taxonomic or phylogenetic significance:

1. Visceral characters:
   (a) Shape of the stomach most closely resembling that of *Ailurus;*
   (b) Lobes of the liver similar to those of *Ailurus;*
   (c) Ileo-colic junction practically identical with that of *Ailurus;*
2. Vascular characters:
   (a) Vena cava inferior double to the level of the kidneys, similar to that in *Ailurus;* (Fig. 15);
   (b) Ovarian veins entering the vena cava inferior directly (neither of them enters a renal vein, a character shared with *Ailurus*);
   (c) Terminal branches of the abdominal aorta similar to those of *Ailurus* (Fig. 2) and differing from the remaining procyonids and at least two genera of ursids.

Although the phylogenetic significance of the characters of the soft anatomy seem to be in general inferior to those of the skull and teeth, yet they do tend to show that the nearest living relative of *Ailuropoda* is *Ailurus* and that its resemblances to the bears are an expression of convergence in size and food habits.

LITERATURE CITED

BEDDARD, FRANK E. 1908. 'On the anatomy of *Antechinomys* and some other marsupials, with special reference to the intestinal tract and mesenteries of these and other mammals.' Proc. Zool. Soc. London, May 26, pp. 561–605.

1909. 'On some points in the structure of *Galidia elegans*, and on the postcaval vein in carnivores.' Proc. Zool. Soc. London, April 27, pp. 477–496.

1909*a*. 'On the postcaval vein and its branches in certain mammals.' Proc. Zool. Soc. London, April 27, pp. 496–526.

CARLSSON, A. 1925. 'Über *Ailurus fulgens*.' Acta Zool., VI, pp. 269–305.

FLOWER, WILLIAM HENRY. 1870. 'On the anatomy of *Ailurus fulgens*.' Proc. Zool. Soc. London, Nov. 15, pp. 752–769.

1872. 'The comparative anatomy of the organs of digestion of the Mammalia. Med. Times and Gazette, I [see pp. 621, 678].

LANKESTER, E. Ray. 1901. 'On the affinities of *Aeluropus melanoleucus*, A. Milne-Edwards.' Trans. Linn. Soc. London, (2) VIII, part 6, pp. 163–172.

MITCHELL, P. CHALMERS. 1905. 'On the intestinal tract of mammals.' Trans. Zool. Soc. London, XVII, part 5, pp. 437–537.

1916. 'Further observations on the intestinal tract of mammals.' Proc. Zool. Soc. London, pp. 183–251.

MIVART, ST. GEORGE. 1885. 'On the anatomy, classification and distribution of the Arctoidea.' Proc. Zool. Soc. London, pp. 340–404.

OSGOOD, W. H. 1932. 'Mammals of the Kelley-Roosevelts and Delacour Asiatic Expeditions.' Field Mus. Nat. Hist., Publ. 312, Zool. Ser., XVIII, No. 10. [*Ailuropoda melanoleuca*, pp. 266–268.]

PARSONS, F. G. 1902. 'On the arrangement of the branches of the mammalian aortic arch.' Jour. Anat. and Physiol., XXXVI, pp. 389–399.

POCOCK, R. I. 1928. 'Some external characters of the giant panda (*Ailuropoda melanoleuca*).' Proc. Zool. Soc. London, pp. 975–981.

SAGE, DEAN. 1935. 'In quest of the giant panda.' Nat. Hist., XXXV, No. 4, pp. 309–320.

SETON, E. T. 1929. 'Lives of Game Animals.' II, Part 1 [see p. 119].

SONNTAG, C. F. 1920. 'The comparative anatomy of the tongues of the Mammalia. I. General description of the tongue.' Proc. Zool. Soc. London, pp. 115–129.

1923. 'The comparative anatomy of the tongues of the Mammalia. VIII. Carnivora.' Proc. Zool. Soc. London, pp. 129–152.

SOWERBY, A. de C. 1932. 'The pandas or cat-bears.' China Jour., XVII, No. 6, pp. 296–299.

1933. 'The pandas or cat-bears and the true bears.' China Jour., XVIII, pp. 257–259. [See especially p. 258.]

YOUNG, A. H., AND ROBINSON, A. 1898. 'The development and morphology of the vascular system in mammals. I. The posterior end of the aorta and the iliac arteries.' Proc. Roy. Soc. London, LXII, pp. 350–352.